Load Pulse Width and Deflection Analysis Using HWD and MDD Data at National Airport Pavement Test Facility

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Objectives

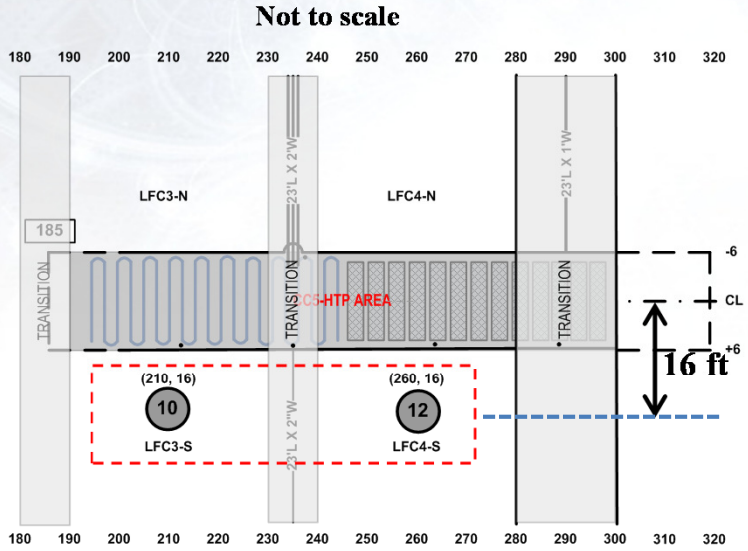
- Validate the HWD data by comparing to the measured MDD data
- Find appropriate HWD load amount level for airfield pavements
- Propose a pulse width computation method using the data from the HWD and MDD
- Investigate temperature dependency of the HWD results

Test Conditions

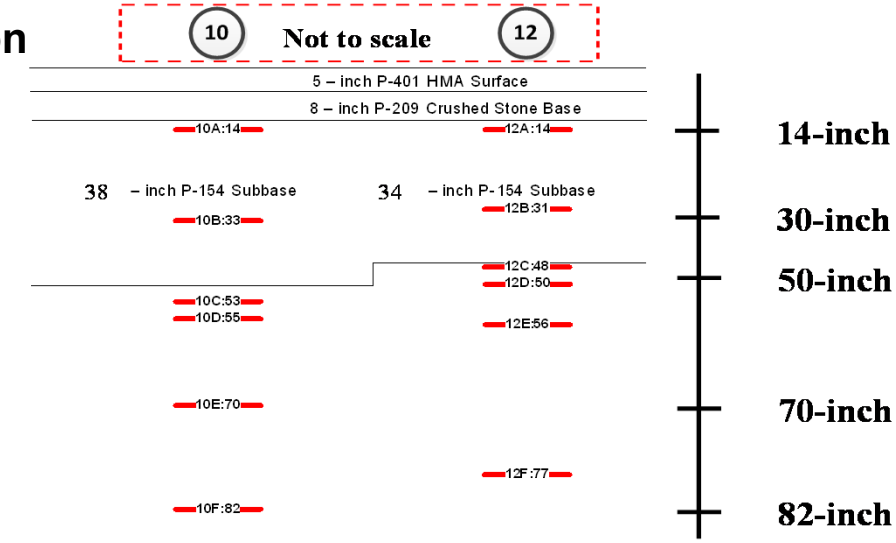
- CC5 in the NAPTF: 5 inches of Hot Mix Asphalt (HMA) surface layer (P-401), 8 inches of base course (P-209), 34 and 38 inches of granular materials (P-154) constructed on a CH clay subgrade known as DuPont clay subgrade
- KUAB Model 240 HWD with 12,000 lbs, 24,000 lbs, and 36,000 lbs at pavement surface temperatures ranging between 47 and 86°F
- MDD deflectometers in the P-154 and in the subgrade

Pavement Structures and MDD Locations

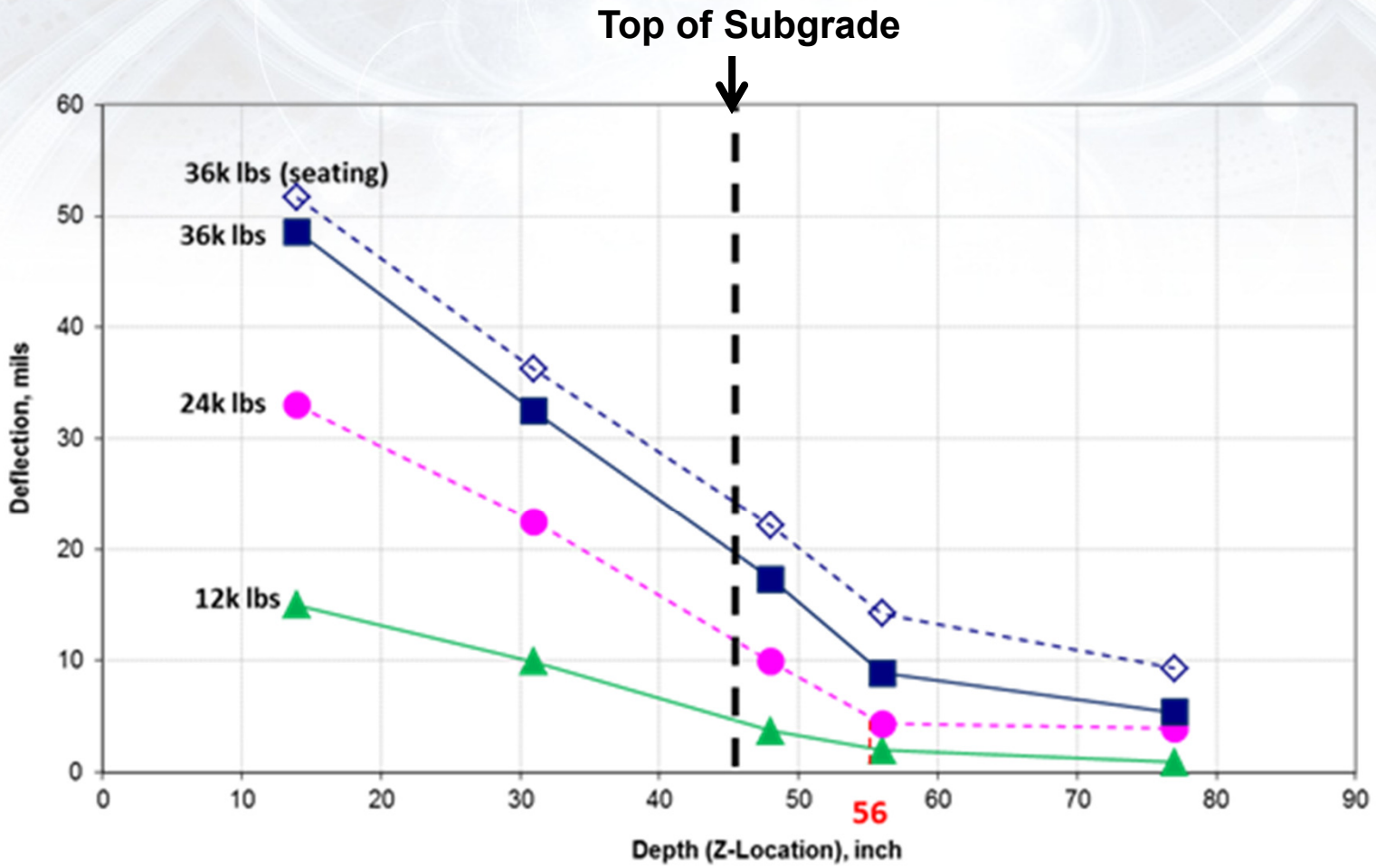
Plan View



Cross Section



Load Magnitude

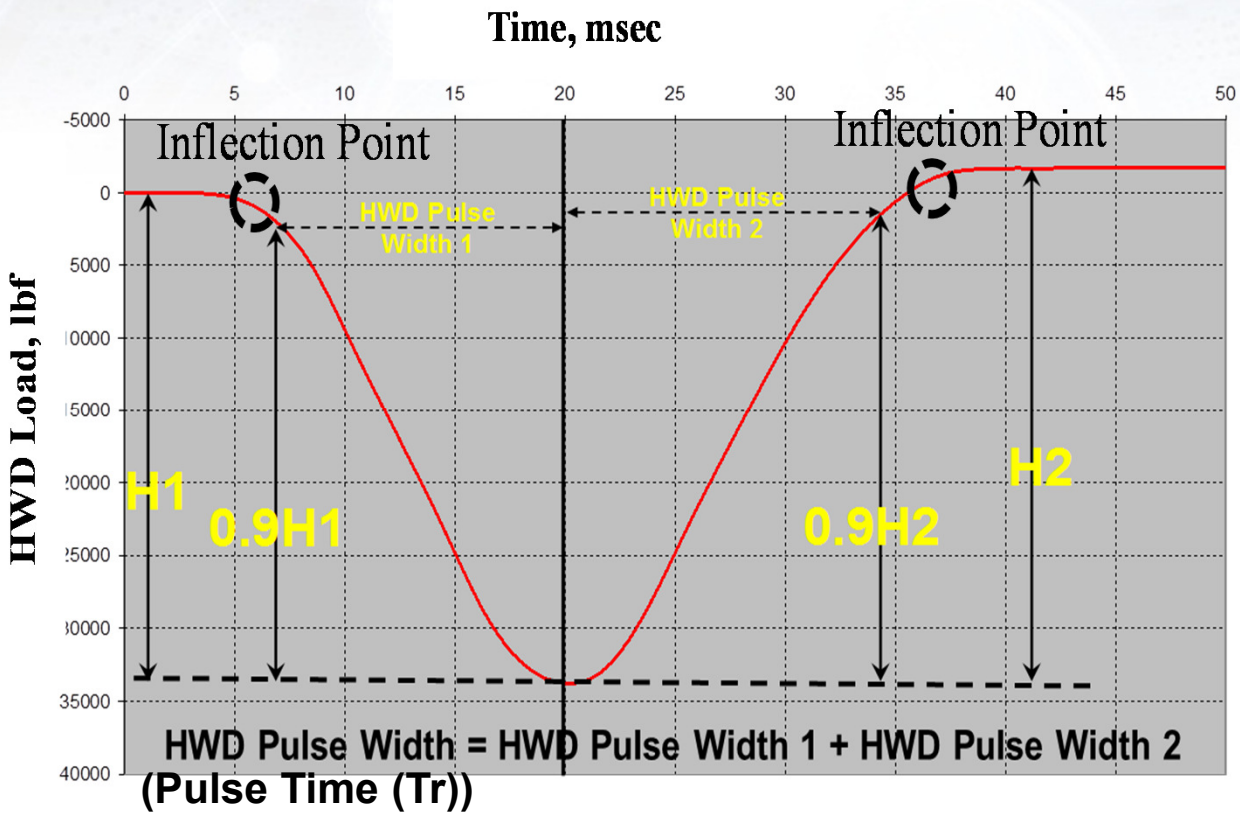


Load Pulse Width

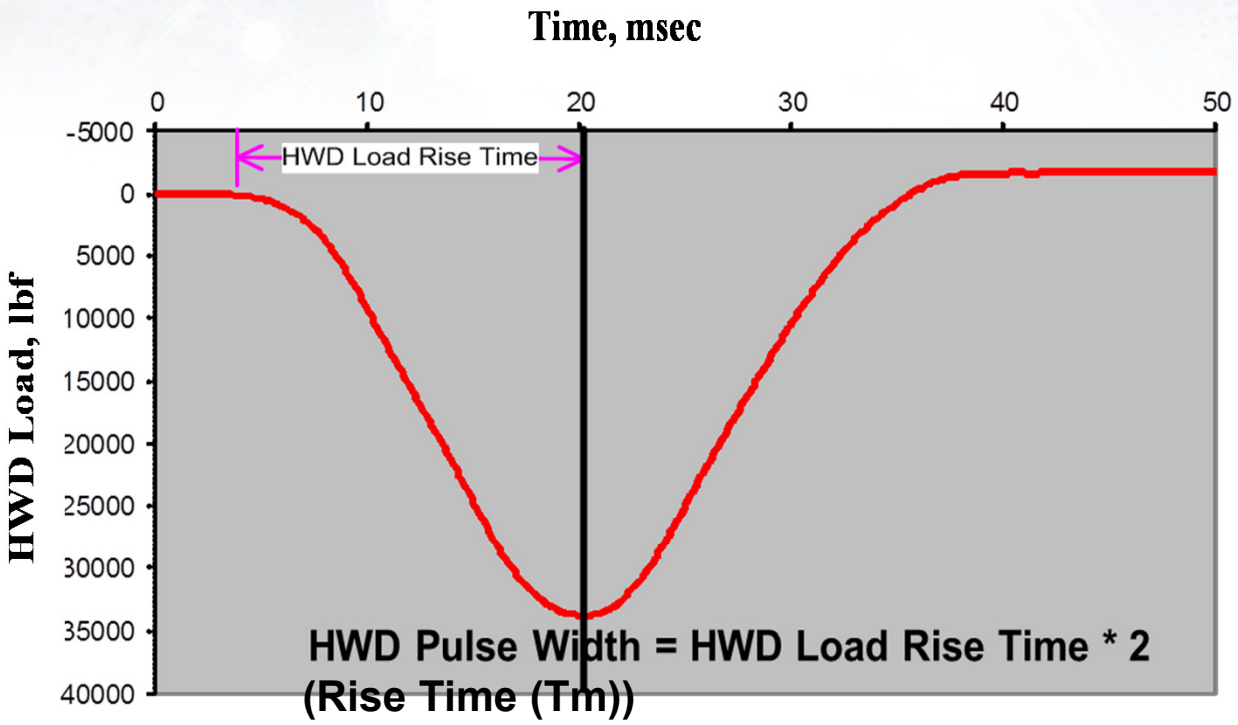
- Based on time domain plots in milliseconds (msec) and the KUAB load shapes, three approaches to compute the load pulse width were examined

1. Pulse Time (Tr): 90 percent of the time from zero slope to peak load on each side of peak value.
2. Rise Time (Tm): Two times of elapsed time from zero slope to peak load.
3. Transient (Tt): Elapsed time between the two steady states (zero slopes).

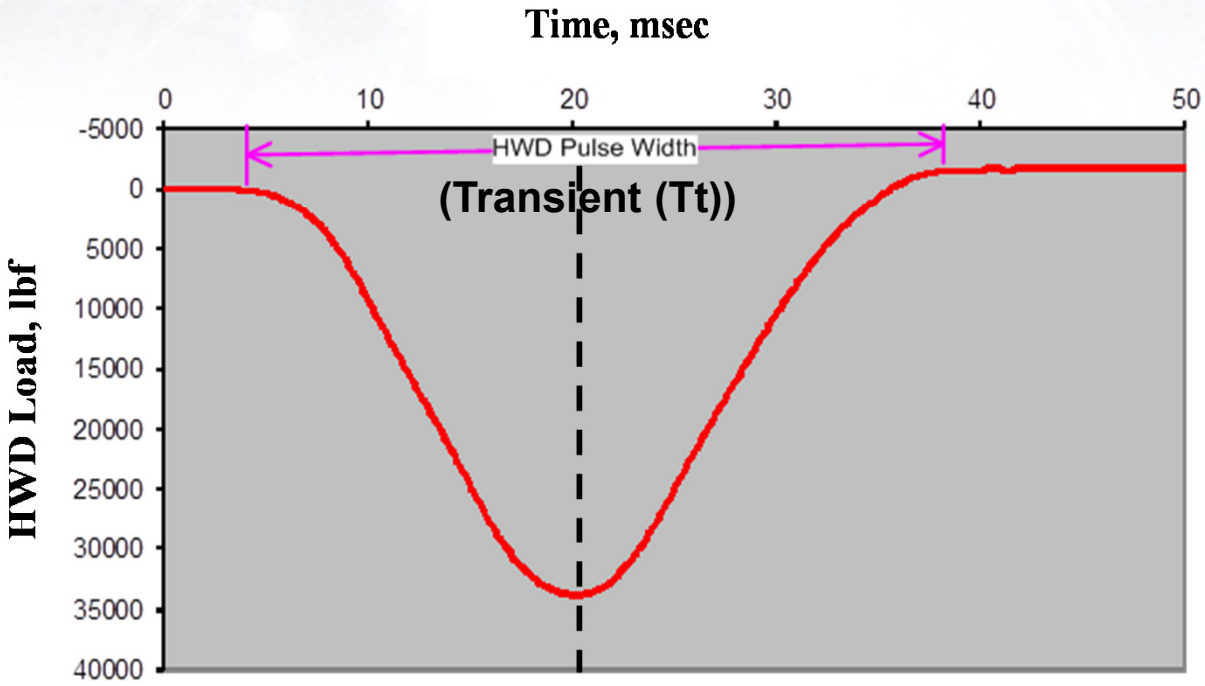
1. Pulse Time (Tr)



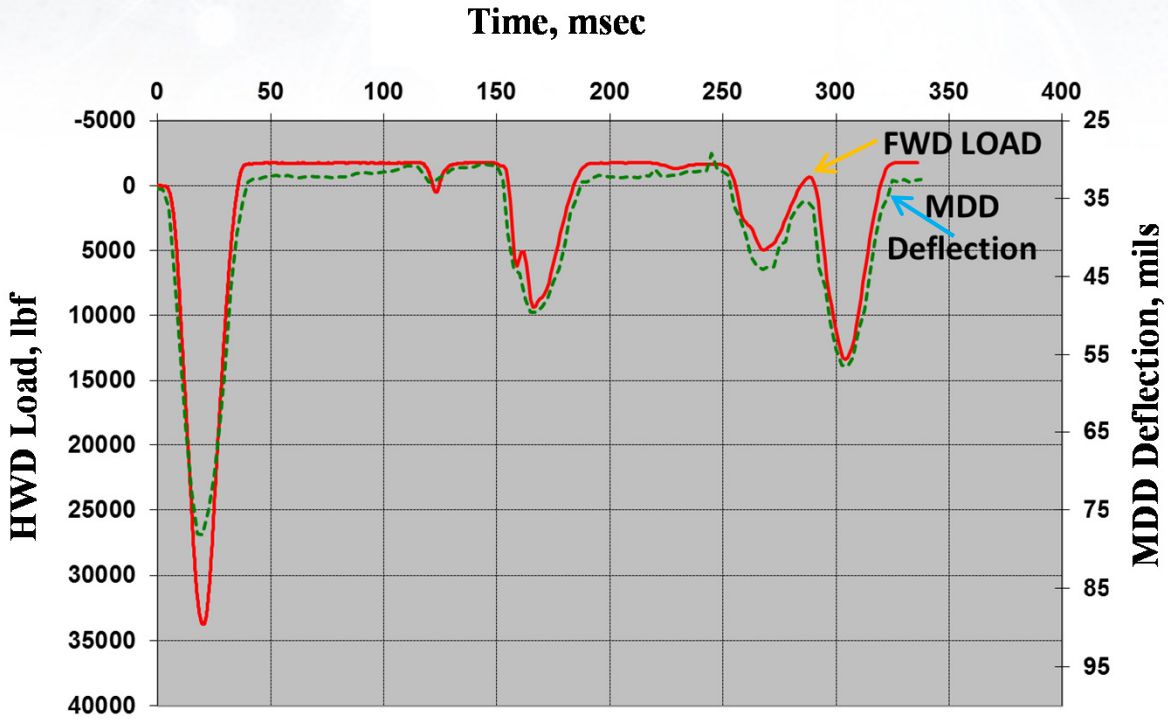
2. Rise Time (Tm)



3. Transient (Tt)



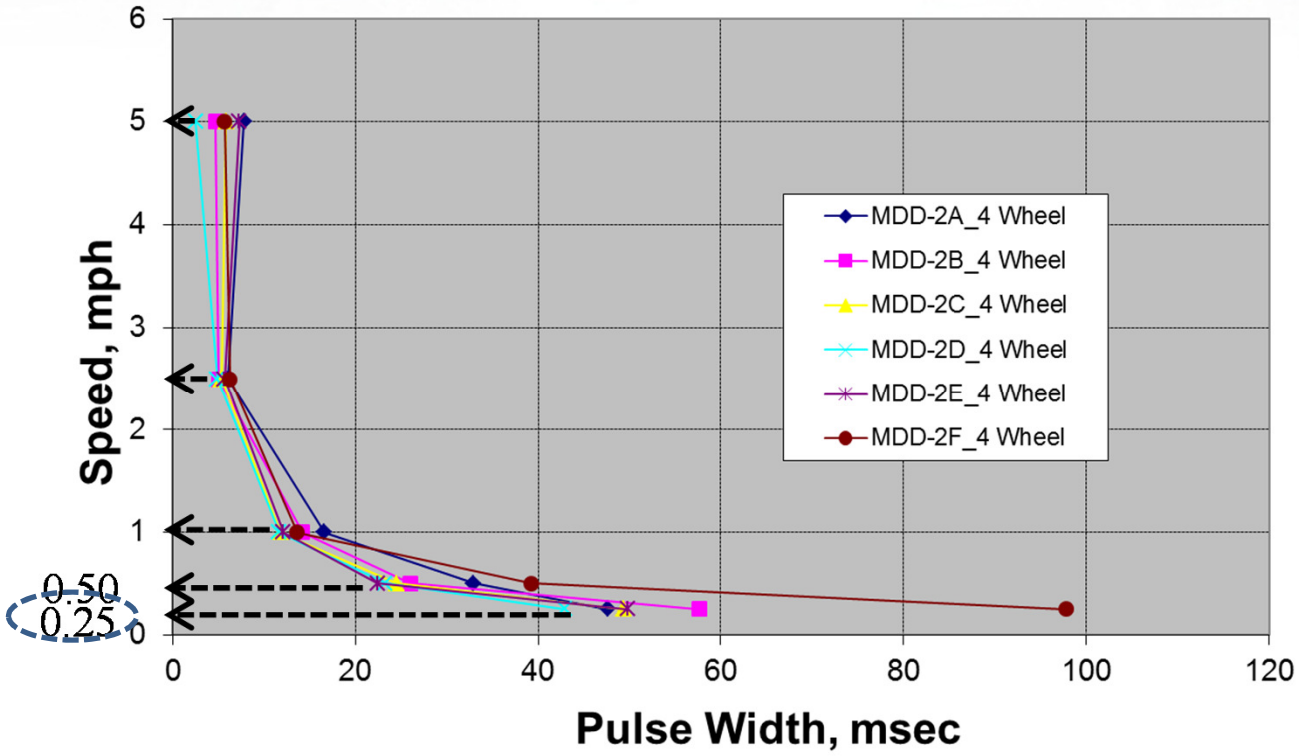
MDD 10 Responses and HWD Recorded Load



Dynamic Loading Conditions for MDD Pulse Width

- The National Airport Pavement Test Vehicle (NAPTV) was applied to monitor pulse width changes in the MDD readings in CC5.
- The test speeds were varied at 0.25, 0.5, 1.0, 2.5, and 5.0 mph with 65,000 lbs wheel loading and 4-wheel gear configurations, 54 and 57 inches between tires and modules, respectively, at inflated tire pressures of 234 psi.

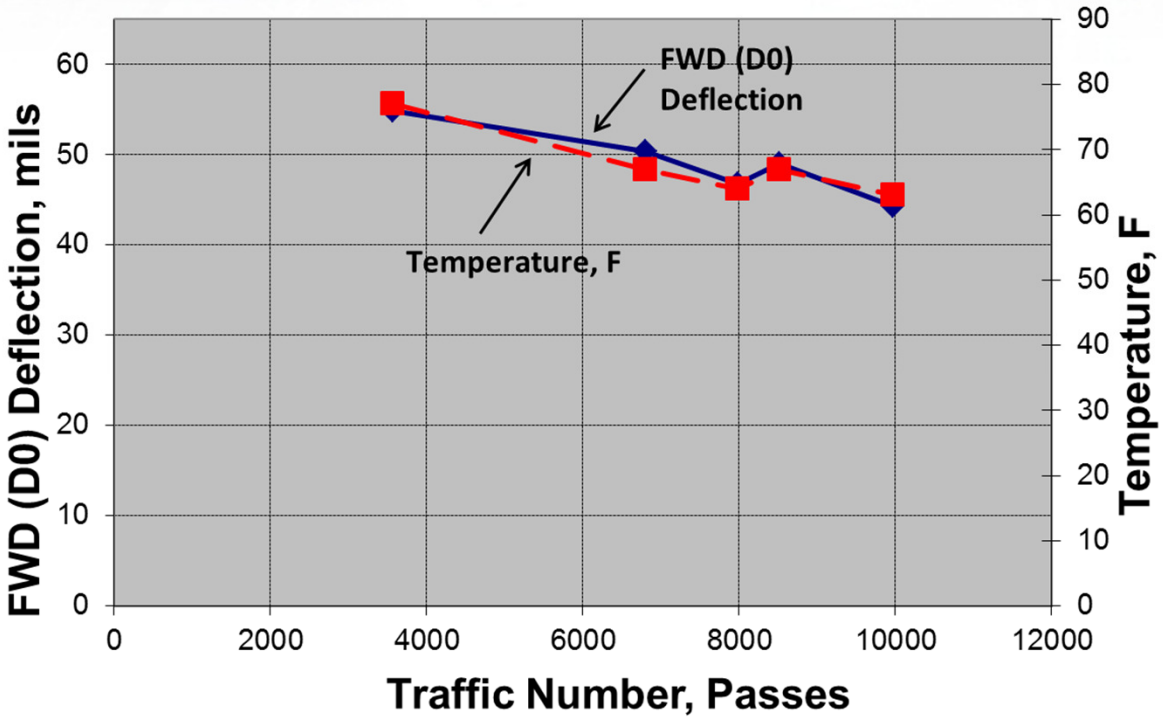
Pulse Width Changes in MDD with Dynamic Loading Speeds



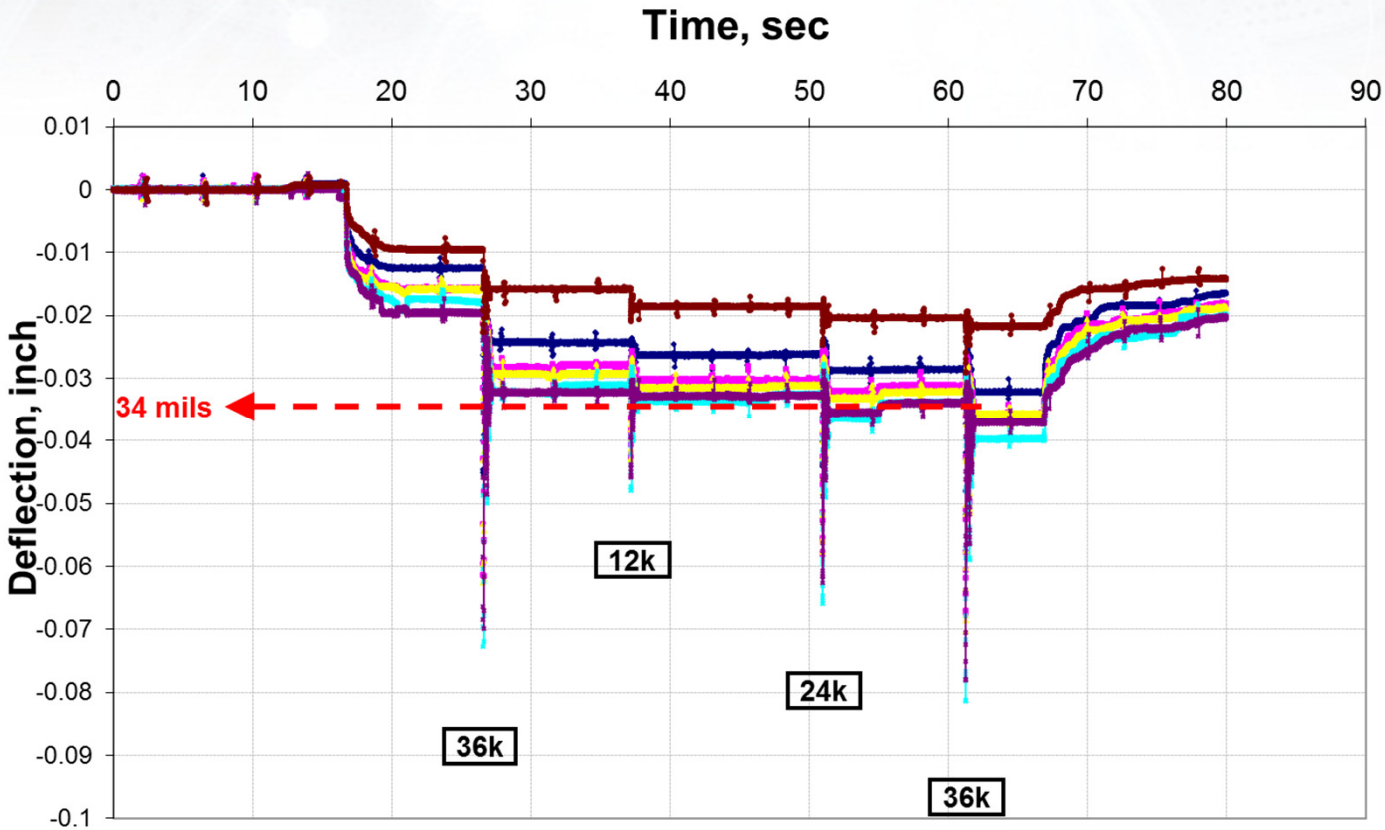
HWD Deflection Changes with Increasing Pavement Surface Temperatures

Pavement Surface Temperature, °F	D0, mils	D1, mils	D0 Increase Ratio, mils/°F	D1 Increase Ratio, mils/°F
47	43.34	32.74	NA	NA
70	46.82	33.99	0.15	0.05
78	51.40	36.65	0.57	0.33
86	57.37	38.96	0.75	0.29

HWD Deflection and Pavement Surface Temperatures



Additional Pavement Deflection



Conclusion

- MDD responses to the measured HWD impact loading shows similar patterns as HWD system recorded load changes.
- Pulse Time (Tr), Rise Time (Tm), and Transient (Tt) were proposed for load pulse measurement. The Pulse Time (Tr) provides the most reasonable computation method including both sides of load generated pulse shape.
- Strong correlations between pavement surface temperatures with HWD deflections were identified.
- MDD monitored load pulse widths at full-scale traffic speed levels show more sensitivity to the pulse width at below 1 mph dynamic loading speed.
- Potential MDD measurement errors (difficulties) were detected caused by the HWD and the towing vehicle weights.

Questions

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